Claims

Add A14

1. Process for manufacturing single part fibre-reinforced components (31) having at least one closed or undercut space (35), in particular a Resin-Transfer-Moulding (RTM) process, whereby a shape-stable supporting core (13) to create the hollow space (35) in the fibre-reinforced component (31) is manufactured and a mould (20) with a cavity (24) is charged at least with fibre material and the supporting core (13), and a plastic matrix (27) capable of flowing is injected into the cavity (24) of the closed mould (20) soaking the fibre material and forming a shaped fibre-composite mass (23), and the fibre-composite mass (23) is hardened resulting in a fibre-reinforced component (31),

   characterised in that,

   the supporting core (13) is a shaped part that can be melted out of the fibre-reinforced component (31) above room temperature and is manufactured by means of plastic deformation from a core mass or preform (1) and, in the process of manufacturing the fibre-reinforced component (31), the supporting core (13) is melted out of the fibre-reinforced component (31) when the component (31) has reached a stable shape containing a closed or undercut hollow space (35).

2. Process according to claim 1, characterised in that the supporting core (13) is plastically shape-formed out of a preform (1) and the preform (1) is preferably cast, in particular in a rough or approximate shape of the final supporting core (13), and the shape of the preform (1) is preferably chosen such that the distances the material has to flow during plastic shape-forming is as small as possible and the preform (1) has the same, and preferably a greater mass than the supporting core (13) to be manufactured.

3. Process according to one of the claims 1 to 2, characterised in that the core mass or the preform (19) is plastically shape-formed at an average temperature greater than 20°C, preferably greater than 35°C, in particular greater than 50°C and less than the temperature of melting, whereby the temperature of melting lies above 50°C.

4. Process according to one of the claims 1 to 3, characterised in that the supporting core (13) contains wax, preferably natural, chemically modified or synthetic wax, and preferably is comprised essentially or completely thereof.

5. Process according to one of the claims 1 to 4 characterised in that the core mass or preform (1) exhibits a temperature of melting which is at least 75°C, preferably at least 85°C, and in particular at least 90°C and at most 130°C, preferably at most 120°C and in particular at most 110°C, and the core mass or preform (1) can be plastically formed from a temperature of at least 20°C, preferably of at least 30°C, in particular of at least 50°C up to the temperature of melting.

6. Process according to one of the claims 1 to 5, characterised in that the supporting core (13) is manufactured via press-moulding and is shape-formed in a cavity (14) of a press-moulding tool, preferably in a press-moulding tool featuring a multi-part mould, in particular a two-part mould (10), whereby the core mass or preform (1) is laid in the open cavity (14) and, by bringing the mould parts (11, 12) together and closing the press-moulding tool, is pressed into the shape of the cavity (14) thus giving the supporting core (13) its final shape.

7. Process according to one of the claims 1 to 6, characterised in that the preform (1) is laid in an open two-part press-moulding tool (10) forming a tool cavity (14), whereby the press-moulding tool parts form cavity parts and the press-moulding tool cavity (14) makes up the hollow space in the fibre-reinforced component to be manufactured and, by closing the press-moulding tool (10), the core mass or preform (1) is pressed by shape-forming into the contour of the press-moulding tool cavity (14) and pressed to give a shaped supporting core (13).

8. Process according to one of the claims 1 to 7, characterised in that the core mass or preform (1) exhibits excess material with respect to the final, shaped supporting core (13) and the excess material is able to flow out of the cavity (14) via openings (15) during the press-mould forming and the cavity (14) contains degassing openings (17) to remove trapped pockets of air during the press-mould forming.

9. Process according to one of the claims 1 to 8, characterised in that a new preform (1) is formed out of the supporting core (13) material removed by melting, and the molten material from the supporting core (13) is led directly into a casting mould (40) in order to produce a new preform (1).

10. Process according to one of the claims 1 to 9, characterised in that the average temperature of the supporting core (13) during the injection of the plastic matrix (27) into the mould (20) deviates by less than ±6°C, preferably less than ±4°C, in particular less than ±2°C from the average temperature of the core mass or preform (1) during the plastic deformation, or the average temperature of the supporting core (13) during the injection of the plastic matrix (27) into the moulding tool (20) corresponds to the average temperature of the core mass or preform (1) during the plastic deformation.

11. Process according to one of the claims 1 to 10, characterised in that the average temperature of the supporting core (13) during the injection of the plastic matrix (27) into the mould (20) is less than 6°C, preferably less than 4°C, in particular less than 3°C and more than 0°C, preferably more than 1°C, in particular more than 2°C higher than the average temperature of the core mass or preform (1) during its plastic deformation, whereby the supporting core (13), during or after the injection of the plastic matrix (27) is heated and a thermal volume expansion towards the fibre-composite mass (23) of more than 0%, preferably more than 1%, and less than 10%, preferably less than 5%, in particular less than 2% and, as a result of the thermal expansion in volume, pressure is exerted on the fibre-composite mass (23) which leads to the plastic matrix (27) effectively soaking into the fibre mass.

12. Process according to one of the claims 1 to 11, characterised in that the fibre-reinforced component (31) is produced in a Resin Transfer Moulding (RTM) process and the plastic matrix (27) is of a duromer system, particulary of a epoxy resin systems exhibiting little shrinkage, and the plastic matrix (27) is injected into the cavity (24) of a multi-part RTM-tool (20) at a temperature of about 60°C and the plastic matrix (27) is hardened at a temperature of about 70-80°C and the fibre-reinforced component (31) is subjected to a tempering process at a temperature of about 90-110°C after re-

moval from the mould and the supporting core (13) is melted out of the fibre-reinforced component (31) during the tempering process.

13. Process according to one of the claims 1 to 12, characterised in that the fibre masses are pre-formed fibre preforms of textile materials.

14. Process according to one of the claims 1 to 13, characterised in that the fibre masses are essentially of glass fibres.

15. Process for manufacturing a supporting core (13) for use in a process, in particular a Resin Transfer Moulding (RTM) process, for manufacturing fibre-reinforced components,

characterised in that,

the supporting core (13) is a shaped body that can be melted at a temperature above room temperature and is manufactured from a core mass or a preform (1) by plastic deformation.

16. Process according to claim 15, characterised in that the supporting core (13) is plastically formed from a preform (1), and the preform (1) is preferably cast, in particular cast in a rough or approximate shape of the final supporting core (13), and the shape of the preform (1) is preferably chosen such that the distances that the material flows during plastic deformation are as short as possible, and the preform (1) is of a mass which is the same as or greater than that of the supporting core (13) to be produced.

17. Process according to one of the claims 15 to 16, characterised in that the core mass or preform (1) is plastically shape-formed at an average temperature greater than 20°C, preferably greater than 35°C, in particular greater than 50°C and less than the temperature of melting, whereby the temperature of melting is above 50°C.

18. Process according to one of the claims 15 to 17, characterised in that the supporting core (13) contains wax, preferably natural, chemically modified or synthetic wax, and preferably is comprised essentially or completely thereof.

19. Process according to one of the claims 15 to 18, characterised in that the core mass or preform (1) exhibits a temperature of melting of at least 75°C, preferably at least 85°C and in particular at least 90°C and at most 130°C, preferably at most 120°C and in particular at most 110°C, and the core mass or preform (1) can be plastically shape-formed from a temperature of at least 20°C, preferably at least 30°C, in particular at least 50°C up to the melting point.

20. Process according to one of the claims 15 to 19, characterised in that the supporting core (13) is manufactured by press-moulding and is formed in a cavity (14) of a press-moulding tool, preferably in a press-moulding tool featuring a multi-part mould, in particular a two-part moulding tool (10), whereby the core mass or preform (1) is laid in the open cavity (14) and, by bringing the mould parts (11, 12) together and closing the press-moulding tool, is pressed into the shape of the cavity (14) thus giving the supporting core (13) its final shape.

21. Process according to one of the claims 15 to 20, characterised in that the preform (1) is laid in an open two-part press-moulding tool (10) forming a tool cavity (14), whereby the press-moulding tool parts form cavity parts and the press-moulding tool cavity (14) makes up the hollow space in the fibre-reinforced component to be manufactured and, by closing the press-moulding tool (10), the preform (1) is pressed by shape forming into the contour of the press-moulding tool cavity (14) and pressed to give a supporting core (13).

22. Process according to one of the claims 15 to 21, characterised in that the preform (1) features, with respect to the final shape of the supporting core (13), an overspill of material and, during plastic deformation, the overspill is able to flow out of the press-moulding tool cavity (14) via openings (15), and the press-moulding tool cavity (14) features degassing openings (17) for removing trapped pockets of air.

23. Device for manufacturing a supporting core according to claim 15,

characterised in that,

the device is a two-part press-moulding tool (10) which, in the closed position, forms a cavity (14), and the cavity (14) reproduces the hollow space in the fibre-reinforced component (13) to be produced.

24. Device according to claim 23, characterised in that the press-moulding tool (10) contains degassing openings (17) for removing air from trapped air pockets and contains drainage openings (15) leading to drainage chambers (16) to drain off excess material from the preform (1) out of the tool cavity (14) during plastic shape-forming.

25. Single part fibre-reinforced components (31), manufactured using the process according to claim 1,

characterised in that,

the fibre-reinforced components (31) exhibit a fibre content by volume of more than 30% and contain at least one closed or undercut space (35), and the span of shape and dimensional tolerances, in particular wall thicknesses, is less than 5% with reference to a nominal value.